CHICAGO

National Weather Service Forecast Office Chicago

Weather Currents

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Inside this issue:

Strong to Violent Tornadoes During the Cool Season (Oct 16-Apr 15) and Relation to ENSO Phase

by Ricky Castro, Meteorological Intern

In our winter 2010-2011 outlook issued in the Fall 2010 newsletter (http://www.crh.noaa.gov/images/lot/newsletter/fall2010.pdf), we included data to indicate that there is an enhanced potential for cool season severe weather, including significant tornadoes (F-2 or higher), during the cold phase of ENSO, or La Niña. However, in meteorological winters from 1950 to 2010, there were only 8 significant tornadoes within the NWS Chicago forecast area of northern Illinois and northwest Indiana.

For the winter of 2011-2012 outlook, to increase the size of the data sample and thus the statistical significance of the tornado data, we opened up the cold season to a broader definition of mid-October to mid-April "cool season" and included all significant tornadoes that have occurred during the cool season since 1880. We have significant tornado data for Illinois and Indiana dating back to 1880 thanks to a study and book by Thomas P. Grazulis and a study by Valparaiso meteorology student Anthony Lyza (http://www.crh.noaa.gov/lot/?n=cwa_tornadoes). The first recorded cool season significant tornado in the counties of the Chicago forecast area occurred in March 1896 and there have been 48 significant cold season tornadoes from 1880 through the present.

Furthermore, the Japanese Meteorological Agency (JMA) has a much longer running historical record of ENSO Index over the tropical Pacific from 1868 to the present, with a monthly mean SST reconstruction utilized until 1948 and observed SST data from 1949 to the present. This JMA SSTA (anomaly) ENSO dataset is a grouping of Warm Phase (El Niño), Neutral, and Cold Phase (La Niña) episodes together into October-September "ENSO years." For instance, if the SST anomaly index values are 0.5^{o}C or greater for 6 consecutive months, including October-December (OND), the ENSO year of October through the following September is categorized as El Niño. In contrast, if the SST anomaly index values are -0.5^{o}C or greater for 6 consecutive months, including OND, the ENSO year of October through the following September is categorized as La Niña, while neutral refers to all other years. For example, the ENSO year of 2010 started in October 2010 and ended in September 2011. ENSO year 2010 was a La Niña year, and we unfortunately had two EF-2 tornadoes: one that tracked near Peotone and Beecher on October 26th and a second that tracked from southeastern Winnebago County through northwestern McHenry County on November 22nd.

Strong to Violent Tornadoes During the Cool Season (cont)

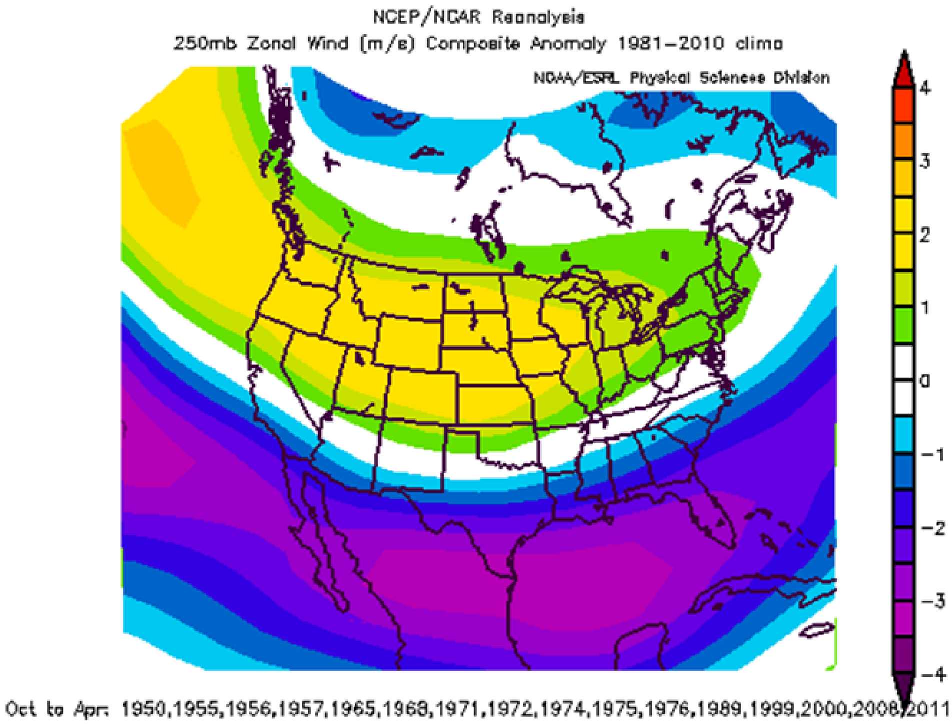
Below is a table containing the ENSO phase relationship of the 48 significant cool season tornadoes that have occurred in the Chicago forecast area since 1880:

Oct 16-Apr 15 Cool Season ENSO status (# of years in dataset)	La Niña (31)	Neutral (72)	El Niño (29)
132 Oct-Sep ' ENSO years' in dataset 1879-2010			
% of years in dataset by ENSO state (expected % of F-2+ tornadoes)	23%	55%	22%
48 total F-2+ Oct 16-Apr 15 cool season tornadoes			
Expected # out of 48 F-2+ tornadoes	11	26	11
Actual # out of 48 F-2+ tornadoes	22	17	9
Actual % out of 48 F-2+ tornadoes	46%	35%	19%
Actual #/expected # = % of exceedance or departure from expected # of F-2+ tornadoes	200%	65%	82%

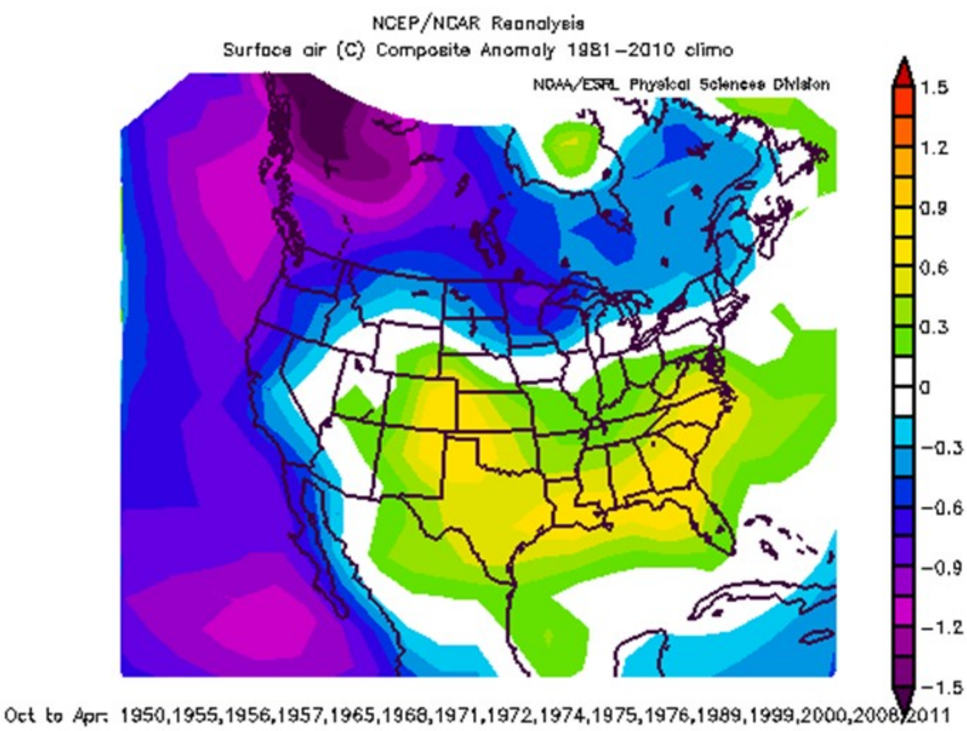
No matter how you slice the data, there is a greatly enhanced potential for significant cold season severe weather during La Niña episodes, including strong to violent tornadoes. The reasoning behind this is largely related to the very active storm track and stronger than normal west to east flow of air at the upper levels (jet stream) that stretches across our region during the colder months. The stronger than normal temperature contrast between very cold air often found across the northern Plains and upper Midwest and the unusually warm air typically found over the southern US is coupled with the enhanced jet stream across the north central US. This set-up increases what is known as wind shear, or the change in wind speed and/or wind direction with height in the atmosphere. Wind shear is a very important ingredient in severe weather and tornadoes. Another important ingredient, warm and humid air, necessary for the atmospheric instability that allows for strong upward motion and the development of thunderstorms, is not typically found over our region during the cool season. However, with La Niña's favoring much warmer than normal conditions to our south during the cool season, a storm system tracking just to the west of the area will allow for this warm and often unseasonably humid air to our south to be transported northward into our region. Our data shows that the increased wind shear and more frequent inroads of warm and humid air in La Niña episodes during the cool season has been an explosive combination in the past, when thunderstorms developed ahead of fronts associated with low pressure systems tracking to our west. As mentioned earlier, the most recent occurrence of significant cool season tornadoes was in October and November 2010. Before that, an EF-3 tornado tracked through Boone and northwestern McHenry counties on January 7, 2008. The November 22, 2010 tornado actually took an eerily similar track to the January 2008 tornado. Even more noteworthy with regard to the January 2008 tornado, it was only the second January tornado to occur on record in the region. The previous January tornado was an F-2 that affected Momence, IL in Kankakee County on January 25, 1950. 1949-1950 was also a La Niña year!

Strong to Violent Tornadoes During the Cool Season (cont)

Below are three graphics that show the favorable atmospheric characteristics for significant cool season tornadoes during La Niña episodes.

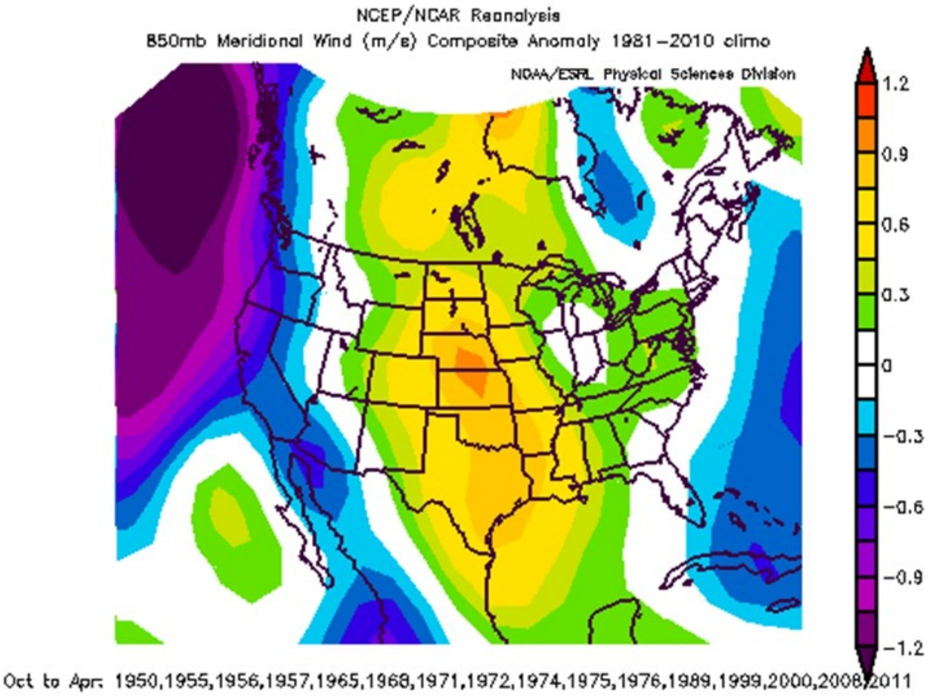


Warm colors represent stronger than average upper level west to east winds, known as the jet stream, across the northern and central US, creating active storm track and enhancing deep layer wind shear.



Much colder than normal air to the north shown by cool colors and warmer than normal air to the south shown by warm colors typically found during at least portions of cool season La Niña episodes.

Strong to Violent Tornadoes During the Cool Season (cont)



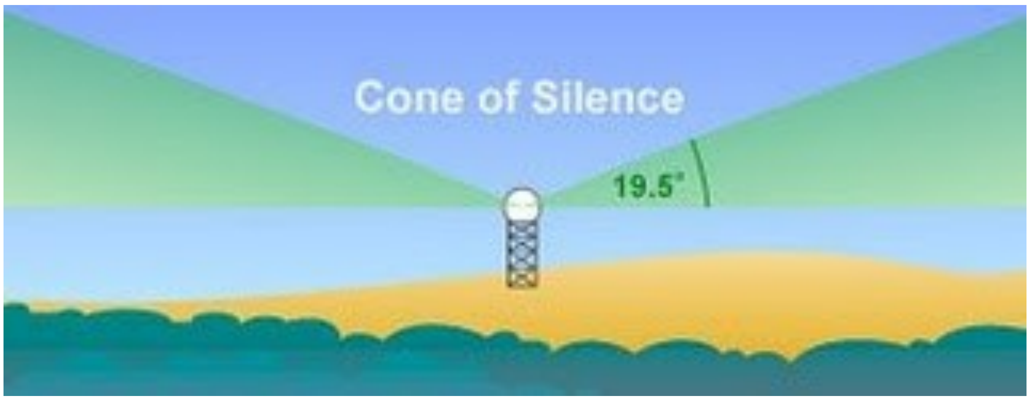
Warm colors represent stronger than normal south to north flow of air, which enables transport of warm and often unseasonably humid air seen on previous graphic northward into our area, when storm systems track to our west, and also greatly enhances low-level wind shear important to tornadogenesis.

In closing, the above data does not mean portions of our area will be visited by a strong to violent tornado during the 2011-2012 cool season. There are several other less predictable ingredients that are needed to support cool season severe weather events. However, it is important to be aware that the large scale atmospheric flow pattern could be more favorable for significant severe weather this upcoming cool season.

What Is The Cone Of Silence?

by Mike Richter, Student Volunteer, Valparaiso University

The cone of silence is an area directly above the National Weather Service WSR-88D Doppler radar that cannot be seen by the beam. The maximum tilt elevation of the radar beam is 19.5 degrees. So, this leaves a cone shaped area above the radar that is not seen simply because the radar beam is unable to see that area as it completes its scan. If a storm moves over the radar, there will be a hole in the radar's reflectivity data because the beam is unable to "see" the rain directly over the radar.

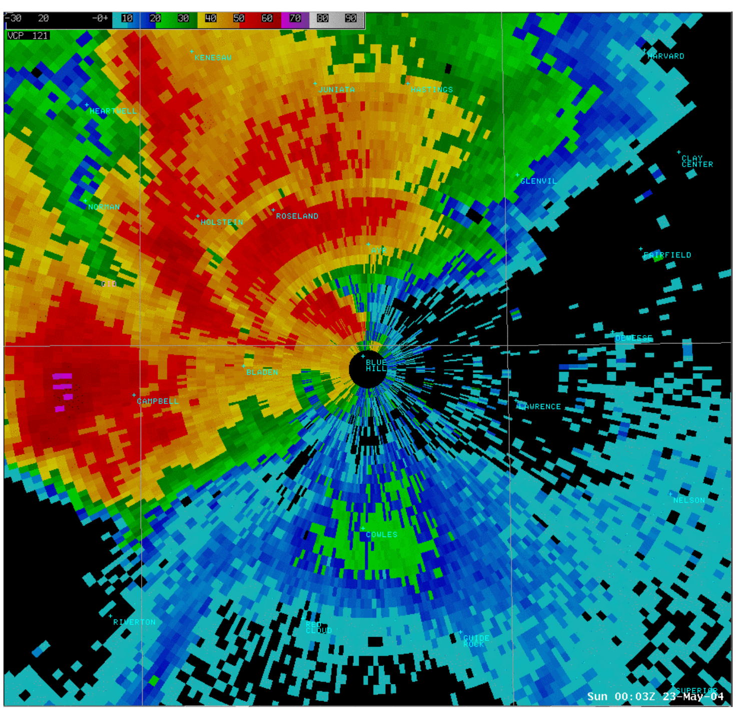


What kinds of problems can the cone of silence cause?

If a storm passes over the radar and into the cone of silence, one would not be able to see any kind of reflectivity from the part of the storm that is directly above the radar. Furthermore, if a supercell finds its way into the cone of silence, meteorologists wouldn't be able to monitor the rotation of the storm for the threat of tornadoes as well as they could. For example, if the storm develops a hook echo, one possibly wouldn't be able to see it because it would be hidden by the cone of silence.

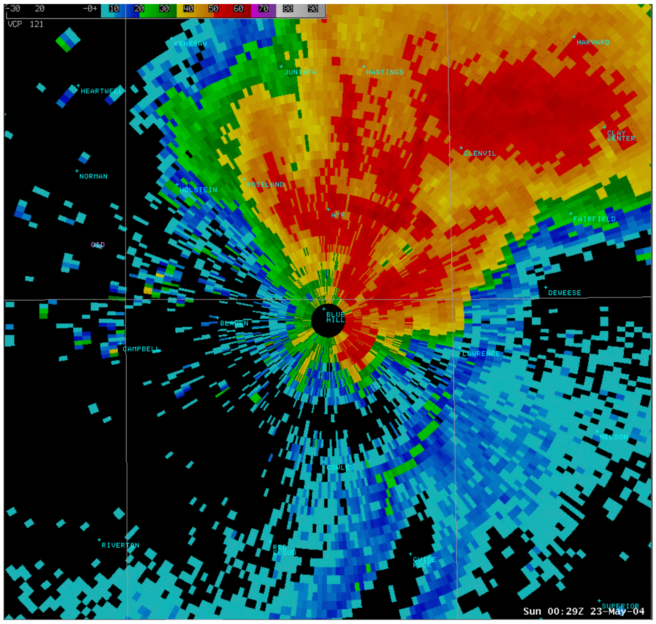
What is an example of how the cone of silence distorted a radar image?

The following reflectivity scan is of one of the supercells that formed during the May 2004 Tornado Outbreak in south central Nebraska. This particular supercell that made its way into Adams and Webster Counties in Nebraska was more difficult to analyze because the storm found its way into the cone of silence.



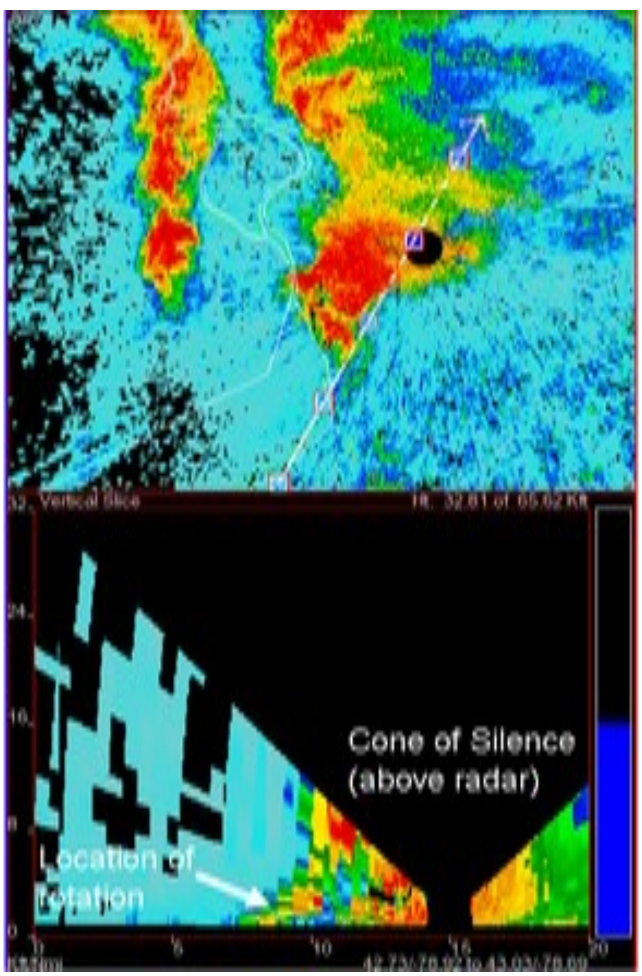
You can see the hook echo of the supercell passing into the cone of silence. This made it difficult for meteorologists to monitor the rotation and strengthening or weakening of the storm since the cone of silence basically cut a hole out of the supercell.

What Is The Cone Of Silence? (cont)



In this scan, the storm has moved away from the top of the radar and out of the cone of silence.

http://www.crh.noaa.gov/gid/?n=05_22_04_tornado

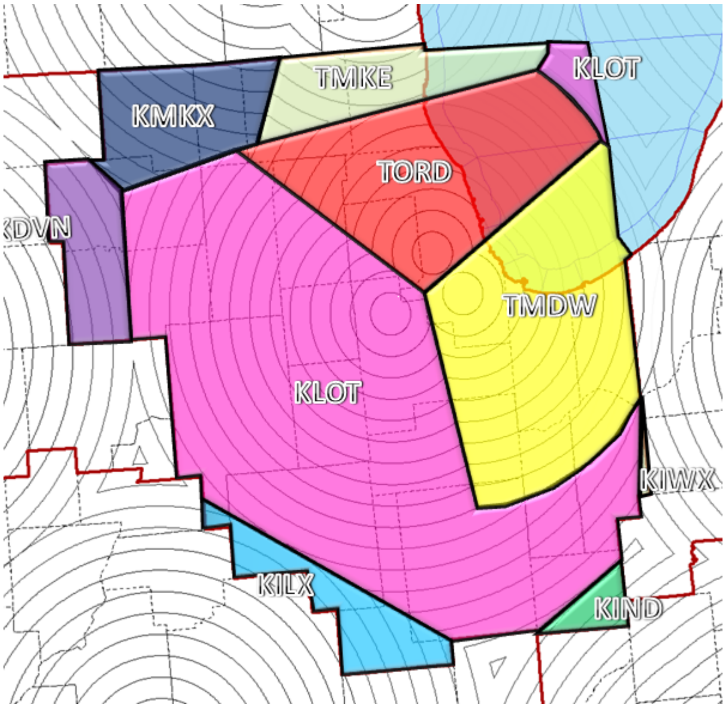


This example is from a supercell that formed in Buffalo, NY in July of 2009. Once again, unfortunately, the storm passed directly over the radar into the cone of silence and made it difficult for meteorologists to monitor the rotation of the storm. Thankfully, if a storm passes directly over the radar, a meteorologist can look at scans from another radar to get a better image of the storm. For example, if a supercell makes its way directly over the NWS in Chicago, meteorologist there can use the radar in the Quad Cites or in Indianapolis to get a better image of the storm.

Radar Coverage at the National Weather Service in Chicago

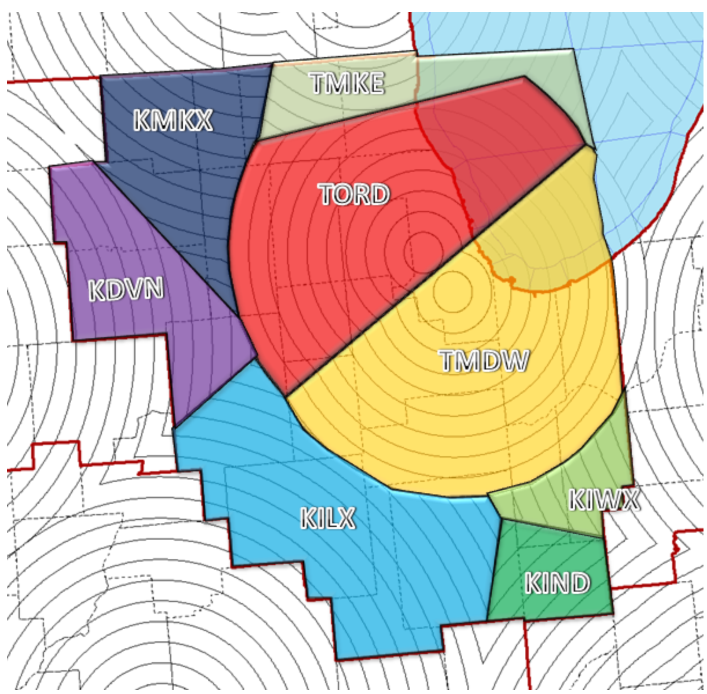
by Mike Richter, Student Volunteer, Valparaiso University

Below is an image that displays the coverage of the radar at the NWS in Chicago (KLOT). The range rings depicted on the image are five statute miles apart. Our radar is very useful for many things. Just a few of the things our radar can do is give us an idea of a storm's strength, height, and movement. It should be noted, however, that the radar at the NWS in Chicago isn't always the best radar to use when viewing a storm for velocity information. The radar's beam only measures velocities of the storm when the storm is moving directly towards or away from the radar. If a storm is moving perpendicular to the radar beam, the beam won't pick up any velocities from the storm. Moreover, if the storm is moving at an angle to the beam, the beam won't record the full velocity of the storm since it is not traveling directly towards or away from the beam. So, it is sometimes necessary to look at other radar sites when looking for velocity information.



What other radars can be utilized if the WSR-88D radar at the NWS in Chicago is unavailable?

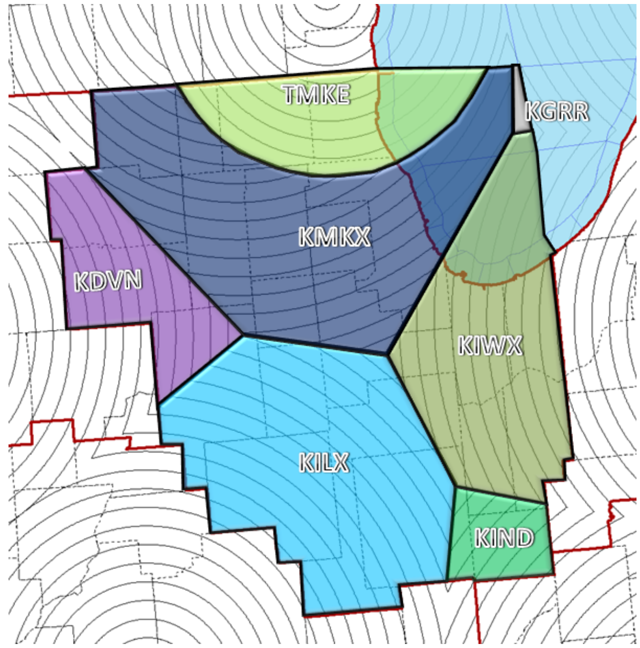
Below is an image of different radar sites and their coverage that can be used if the radar in Chicago is down. The range rings are five statute miles apart. In the very near future, the radar in Chicago will be brought down so that it can be upgraded with dual-polarization capabilities. During the two weeks it is estimated that the radar will be down, please reference the image below. It can be noted that the closest imagery are from the terminal Doppler radars at O'Hare and Midway airports.



Radar Coverage at the National Weather Service in Chicago (cont)

What radars can be utilized if the terminal Doppler radars at O'Hare and Midway are unavailable?

Not all users have access to the terminal Doppler radars at O'Hare and Midway, so the image below displays the Doppler radars available at other weather forecast offices along with their associated coverage. Again, the range rings are five statute miles apart.



School Administrators' Guide to Weather

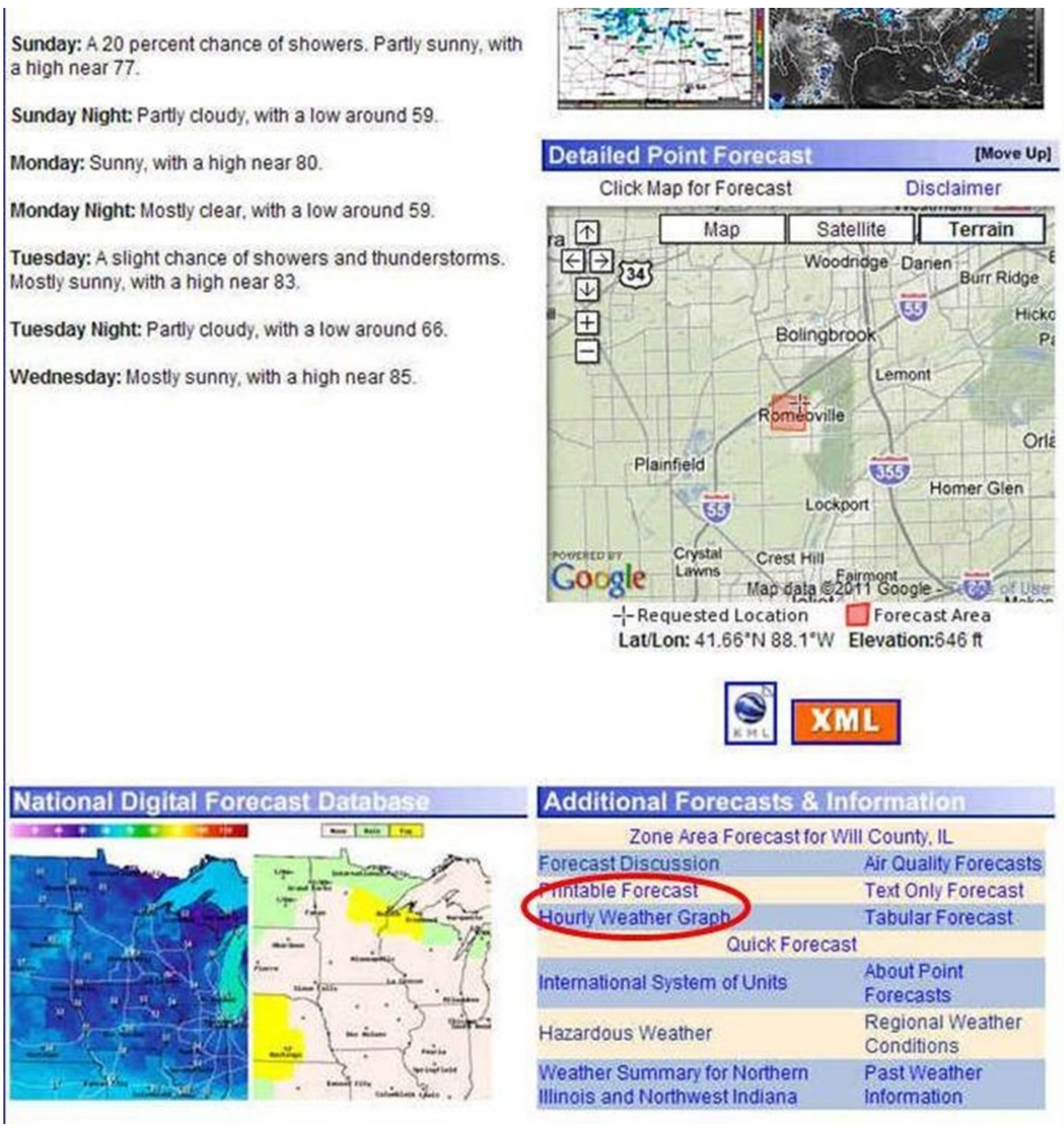
by Jim Allsopp, Warning Coordination Meteorologist

Obtaining the current and forecast weather conditions is critical to school administrators as well as bus drivers and dispatchers. Here are some tips on how to keep up with the latest weather from the National Weather Service.

The web page for the National Weather Service serving north central and northeast Illinois, as well as northwest Indiana is weather.gov/chicago or weather.gov/rockford.

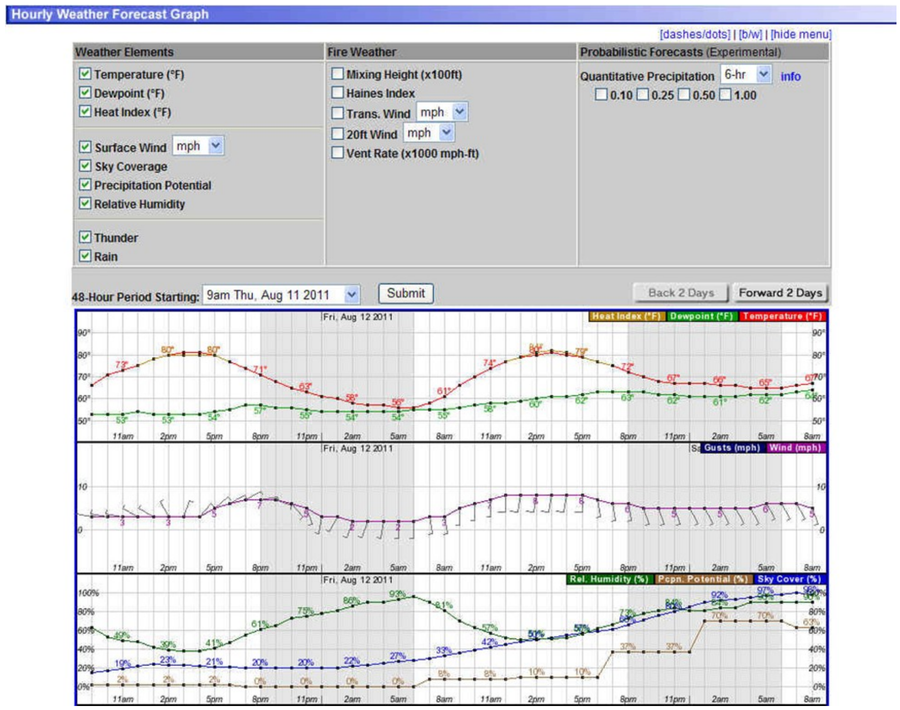
Forecasts

For the complete, detailed 7 day forecast for your school district, just use the point and click map on the main page. Put your cursor over your community on the map, and click. Or you can enter your zip code in the upper left corner of the page. You can also view the forecast as an hourly graph. From your local 7 day forecast page, scroll down to the bottom and under "Additional Forecasts & Information", click on "Hourly Weather Graph".



School Administrators' Guide to Weather (cont)

The hourly weather graph allows you to select the parameters you want to display, including temperature, wind, weather, wind chill and heat index. Then view an hour by hour graph for 48 hour time periods.



Current Weather Conditions

You can view the current conditions for your location, for the Chicago metro area, or for the entire state of Illinois or Indiana. From the homepage, click on the "Observations" tab above the point and click map, or the "Observations" link from the left hand menu.

From the observations page you can view the latest roundup of conditions from Illinois, Indiana, or the Chicago metro area. You can also look at observations from surrounding states.

School Administrators' Guide to Weather (cont)

You can also view the latest radar and satellite images by clicking on the thumbnails below the point and click map, or from the links on the left hand menu.

Hazardous Weather

You can find latest information on watches, warning and advisories from the web page. Large scale, long fused watches, warnings and advisories will be highlighted in color by county on the large point and click map. There is a color key with links to the latest watch, warning and advisory products to the right of the map. Localized, short-fused warnings for severe thunderstorms, tornadoes, and flash floods are issued with small polygon shaped areas based on the speed and movement of the storm, rather than by county. They will be highlighted on the point and click map and also on the radar display.

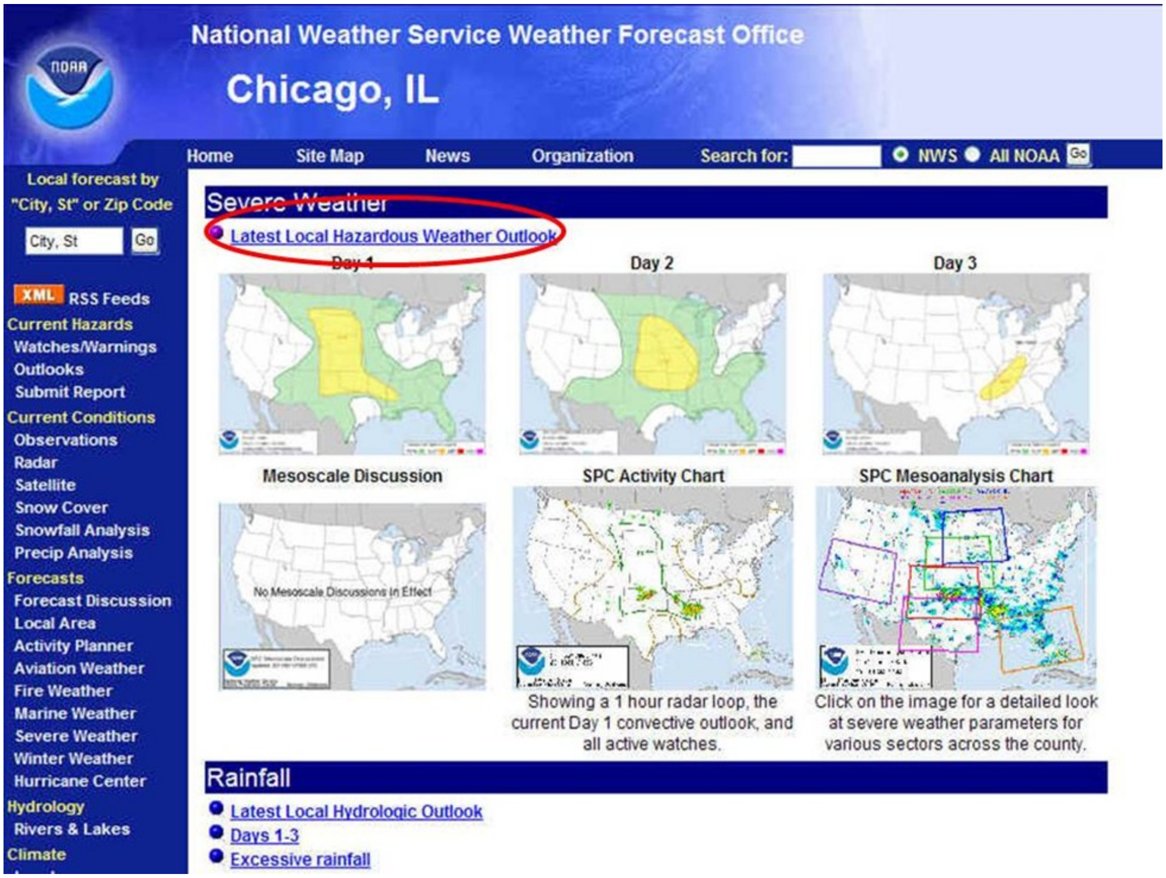
If a major winter storm, significant severe weather outbreak, or other high impact weather or flood event is expected to impact the

School Administrators' Guide to Weather (cont)

local area, you can find a weather briefing page above the point and click map, under "Top News of the Day". The weather briefing page will provide you with everything you need for the storm including the latest watch and warning statement, the Hazardous Weather Outlook, current conditions, radar, storm reports, safety and preparedness information, and more.

For other significant weather, check the daily Hazardous Weather Outlook. It is the first item on the "Outlooks" page.

School Administrators' Guide to Weather (cont)



The Hazardous Weather Outlook is updated at 430 AM and 430 PM, 365 days a year. It is also updated midday during thunderstorm season from March through September. It will be a description of any hazardous weather that is expected to impact the area over the next 7 days, including thunderstorm threats, accumulating ice and snow, high winds, dense fog, extreme temperatures, and more. The outlook will provide timing, location and impacts of any expected hazardous weather.

One of the biggest concerns for schools and school transportation services is winter weather. A one stop shop is set up on our Winter Weather Page. The winter weather page gives the latest information on winter weather watches, warnings and advisories, forecast snow amounts, and winter weather terminology, including definitions/criteria for winter storm watches, warnings and advisories. You can also find a wind chill chart, wind chill calculator, road conditions from Department of Transportation, and more. This information could be critical in making decisions about closing school, late starts, or early dismissals.

Hazardous Weather Planning

It is important that every school have a plan for hazardous weather, especially severe storms and tornadoes. This would include having clearly marked storm shelter areas, redundant methods of receiving warnings, one of which should be a tone alert NOAA Weather Radio, training for all staff and students, an efficient method of alerting parents of any weather disaster at the school, and of course periodic drills to test the plan. For more information, please view our Weather Safety Guide for Schools. If you need assistance developing your severe weather preparedness plan or determining the safest storm shelter areas in you school, contact your local or county emergency management agency, fire department, or contact the National Weather Service at 815-834-1435.

Additional Resources

The National Weather Service can send a meteorologist to your school to provide training for staff, bus drivers or to give a presentation to students. Student presentations can cover almost any weather related topic including National Weather Service operations, severe weather preparedness, winter weather, climate, and careers. We can also offer tours of the National Weather Service office in Romeoville. Due to size limitations we can only accommodate groups up to the size of a typical classroom. More information on talks and tours can be found here.

La Niña
by Kevin Birk, Forecaster

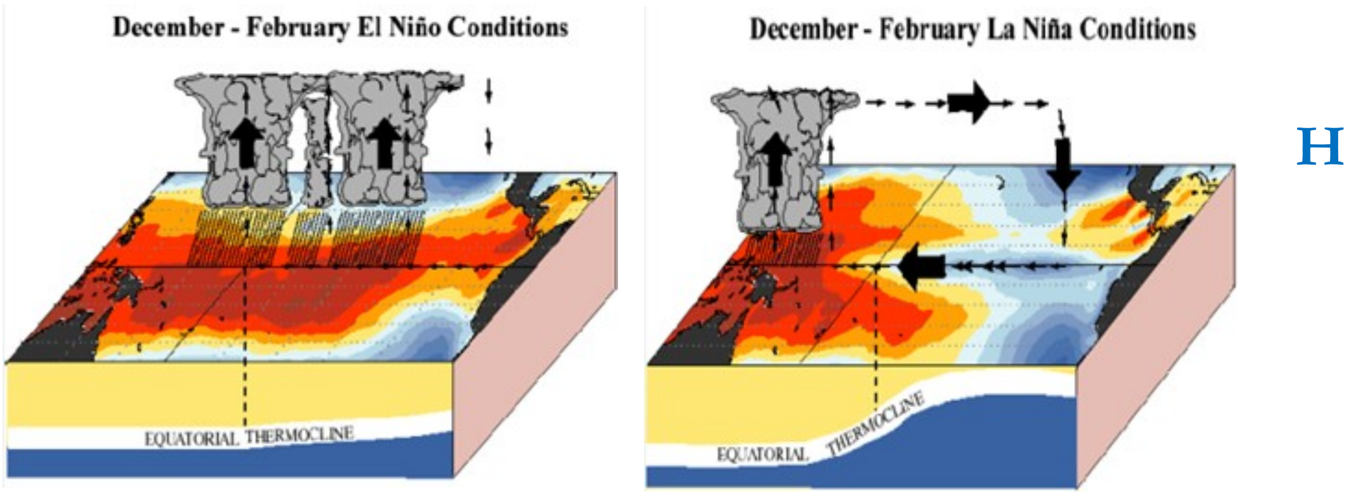


Figure 1. The typical winter season conditions across the equatorial Pacific observed during El Niño (left) and La Niña (right). Courtesy of NOAA, Climate Prediction Center

La Niña conditions, which contributed to some of the extreme weather across much of North America this past year, have reemerged across the equatorial Pacific. It is likely that La Niña conditions will gradually strengthen and continue into the upcoming winter season. So what is La Niña? La Niña is the opposite of El Niño. These two events are the negative (La Niña) and the positive (El Niño) extremes to a naturally occurring phenomena known as the El Niño Southern Oscillation (ENSO). An oscillation is a motion that repeats itself over a period of time. For ENSO that period is between about 3 to 7 years. The defining characteristics of La Niña and El Niño are Sea Surface Temperature (SSTs) anomalies (departures from average) across the central and eastern equatorial Pacific. During La Niña conditions, cooler than average SSTs are found along the equator in the central and eastern Pacific region (right-hand of figure 1 above). Just the opposite occurs during El Niño events (left-hand of figure 1).

The importance of these SST anomalies lies in the fact that they largely dictate where tropical thunderstorms will develop and be the most persistent. Thunderstorms thrive over warm ocean waters in the same way tropical storms and hurricanes do in the Atlantic. During La Niña events, the warmest ocean waters are confined to the western equatorial Pacific region. Therefore, this is the preferred placement for tropical thunderstorms during the Northern Hemisphere cold season. These thunderstorms can be considered as a “bridge” between the ocean and the atmosphere. As these thunderstorms develop, they induce atmospheric low pressure across the western Pacific region, while atmospheric high pressure sets up across the eastern equatorial Pacific where thunderstorms are less favorable (Right-hand of figure 1 above). This leads to stronger easterly trade winds (flow from high to low pressure). In return, these stronger trade winds help reinforce the SST pattern by pushing the warm water west and enhancing the strength of the cool eastern Pacific water. It is this process that produces significant changes to the atmospheric circulation in the tropics and also throughout much of the Northern Hemisphere.

La Niña: (cont)

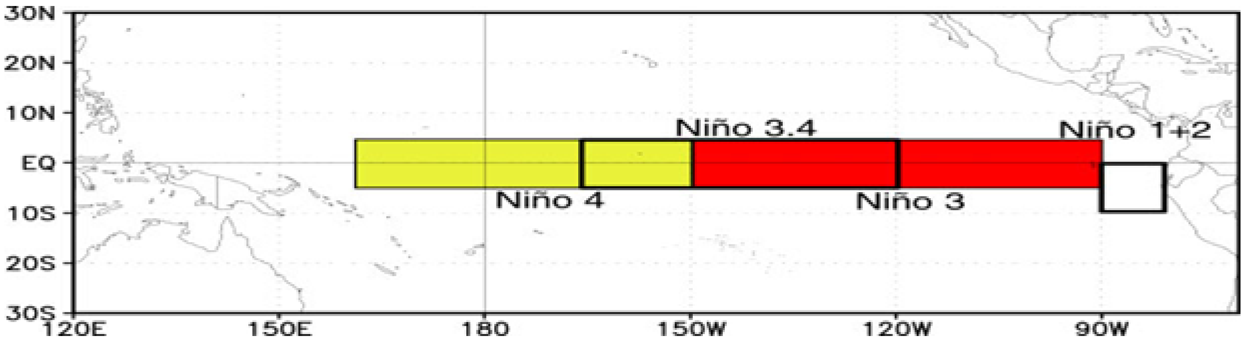


Figure 2. Corridors across the equatorial Pacific used to assess the phase of ENSO. Courtesy of NOAA, Climate Prediction Center

Figure 2 above shows several corridors across the central and eastern equatorial Pacific. SSTs are monitored within these regions. The area labeled as Niño 3.4, which runs from 170° W to 120° W, is used to determine the presence and strength of a La Niña event. If the running monthly average SST anomalies are persistently cooler than -0.5°C within this area, La Niña conditions are present. The strength of La Niña is determined by the extent that the anomalies fall below the -0.5°C threshold. For example a moderate La Niña is in place if the anomalies exceed -1.0°C. Similarly, a strong La Niña is defined as anomalies below -1.5°C.

Usually the stronger an event is, the greater the impact it will have on the placement and strength of the cold season storm track across the Northern Hemisphere. Figure 3 below displays the typical winter season storm track during La Niña events. The main characteristic of the flow pattern is the presence of a large area of high pressure across the North Pacific. This area of high pressure acts as a “block” to the upper level flow which causes the storm track to buckle northward around the high and then southward across western North America. Dynamics associated with this atmospheric flow pattern also tends to favor high pressure across the southeastern United States, which in turn buckles the storm track back northward across the mid-Mississippi valley and the Great Lakes region. The main highlights with this highly meridional (north to south) flow pattern are:

- Tendency for more persistent arctic outbreaks across the Northern Plains and upper Midwest.
- Warmth across the south and southeastern states.
- Above average precipitation in the form of rain and snow across portions of the mid-Mississippi valley eastward through the Ohio Valley.
- Dry conditions in the south.

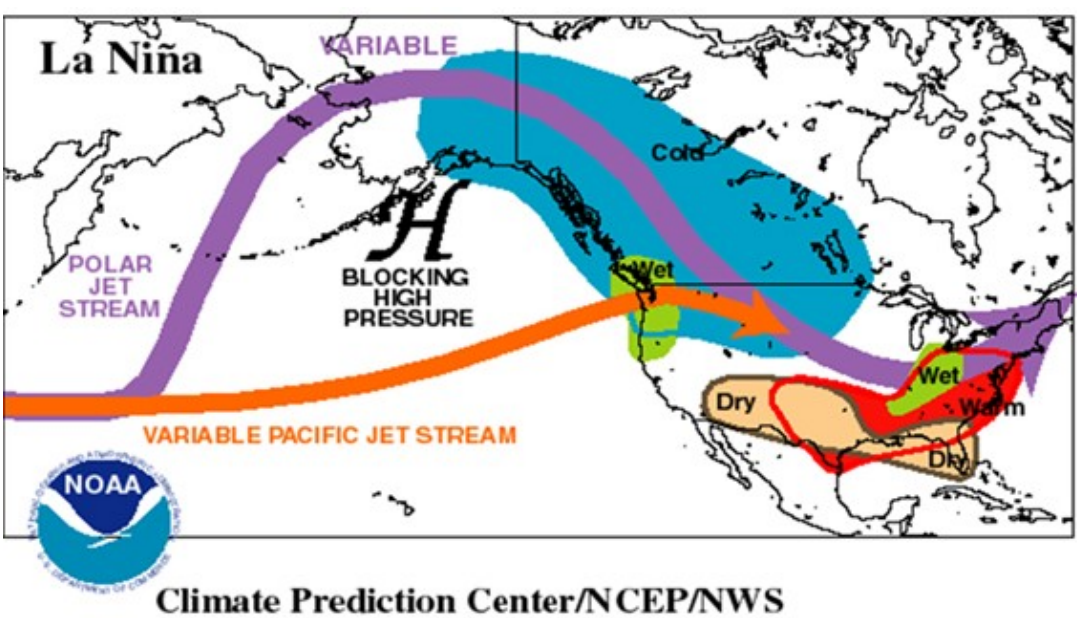


Figure 3. The typical upper level jet stream/storm track during La Niña winters. Courtesy of NOAA, Climate Prediction Center

La Niña: (cont)

Current conditions, shown in figure 4 below, suggest that La Niña conditions are already in place across the equatorial Pacific. The top half of the figure shows observed temperatures across the Pacific while the bottom half of the figure displays the departure from average. Notice that the warmest water is confined to the far west. However, farther east, a tongue of cool water is emerging along the equator in the central and eastern Pacific. The departures from average suggest that SSTs are already in excess of   -0.5°C east of the International Date Line (longitude 180°).

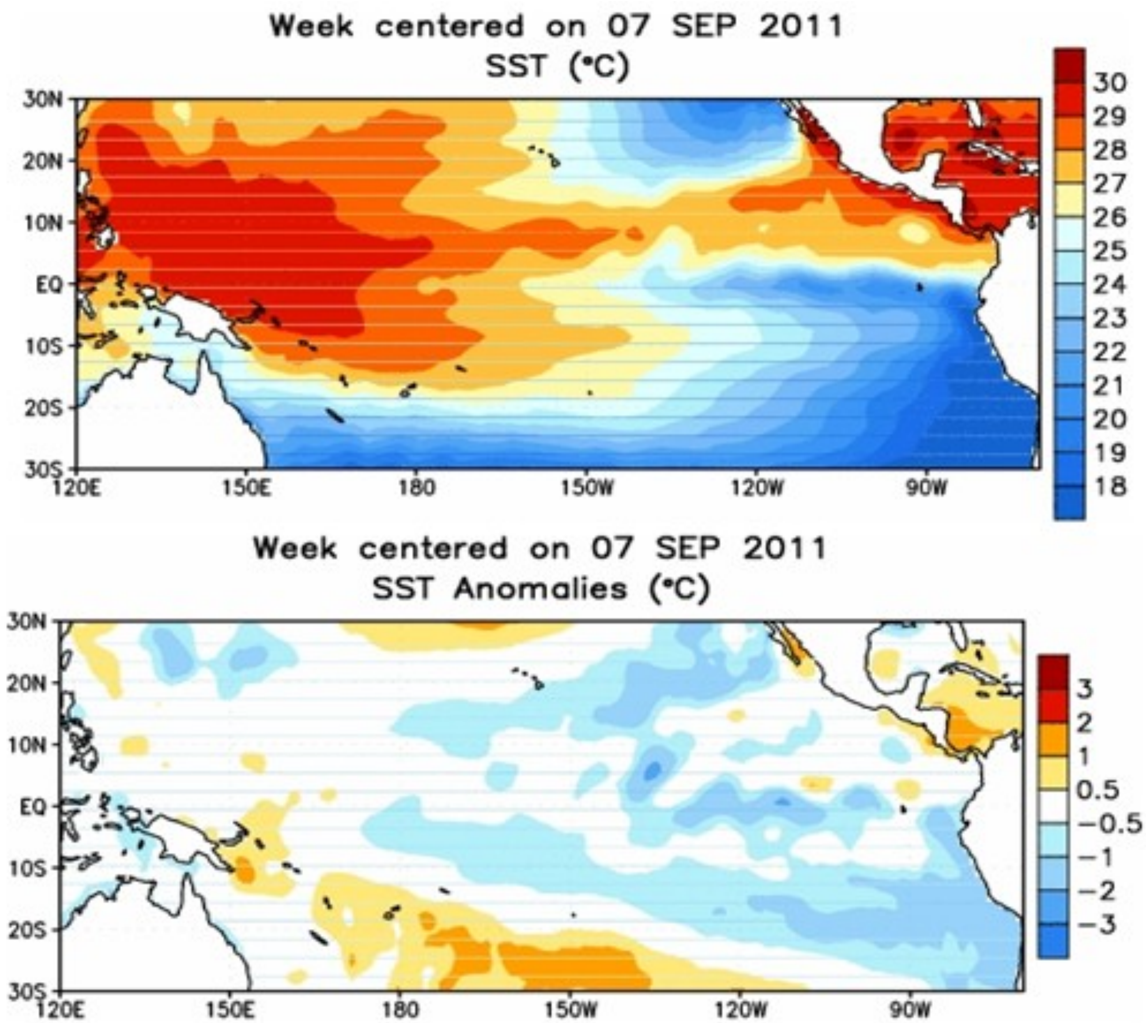


Figure 4. Observed sea surface temperatures across the equatorial Pacific (top) and their departures from average (bottom). Courtesy of NOAA, Climate Prediction Center

La Niña: (cont)

Figure 5 below shows that this La Niña event is expected to strengthen further throughout the autumn season. This figure represents the forecast for the average SST anomalies within the Niño 3.4 region. The black line tracks the past conditions while the red and blue lines represent a group of forecasts (ensembles) for the evolution of SST anomalies. Finally, the dashed black line represents the average of all the forecasts. Overall, although there is still a good amount of spread amongst the ensemble members, this figure shows that the dynamical models are forecasting a good possibility of at least a weak La Niña event for the 2011-2012 winter season.

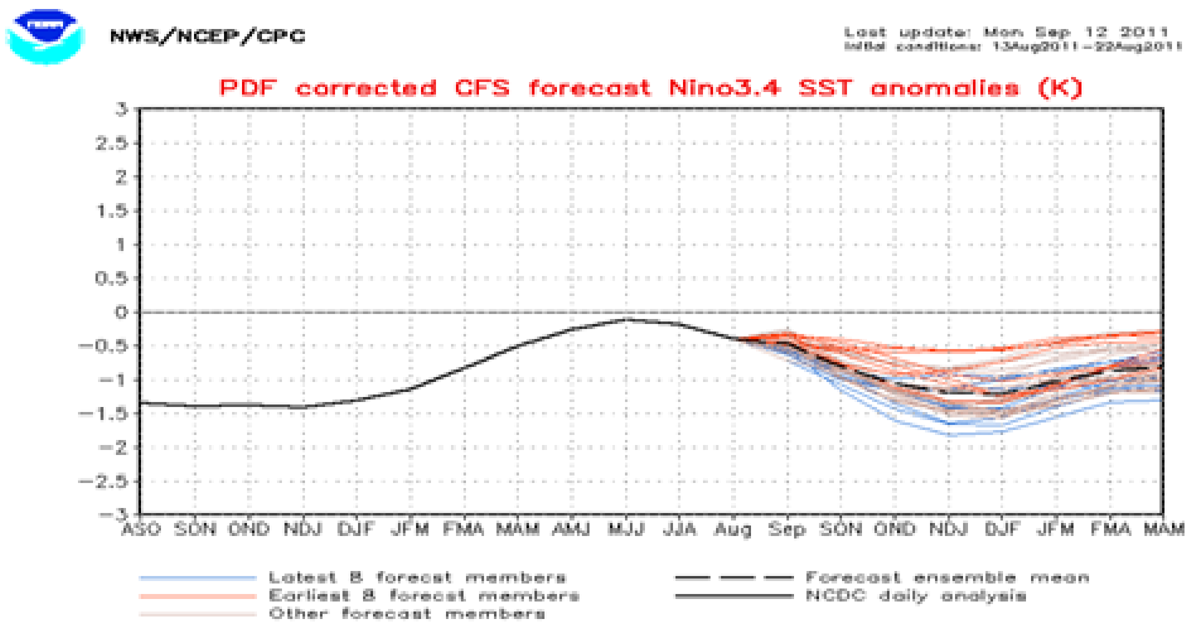


Figure 5. showing the observed 3 month running mean of sea surface temperature anomalies in the Niño 3.4 region (black line) and ensembles of the Climate Forecast System (CFS) model (red and blue lines). Courtesy of NOAA, Climate Prediction Center

The Pacific Decadal Oscillation

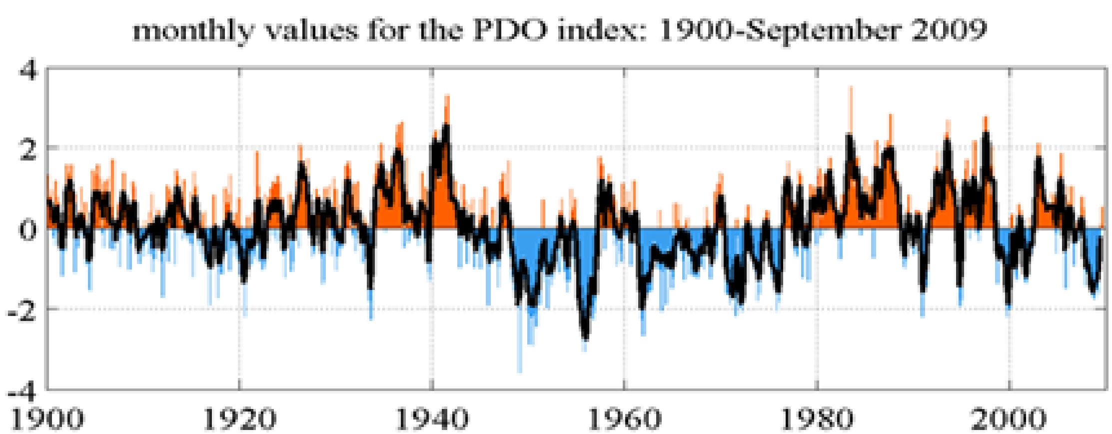


Figure 6. Behavior of the Pacific Decadal Oscillation (PDO) during the 20th and first part of the 21st century. Figure reproduced from http://

La Niña: (cont)

The Pacific Decadal Oscillation

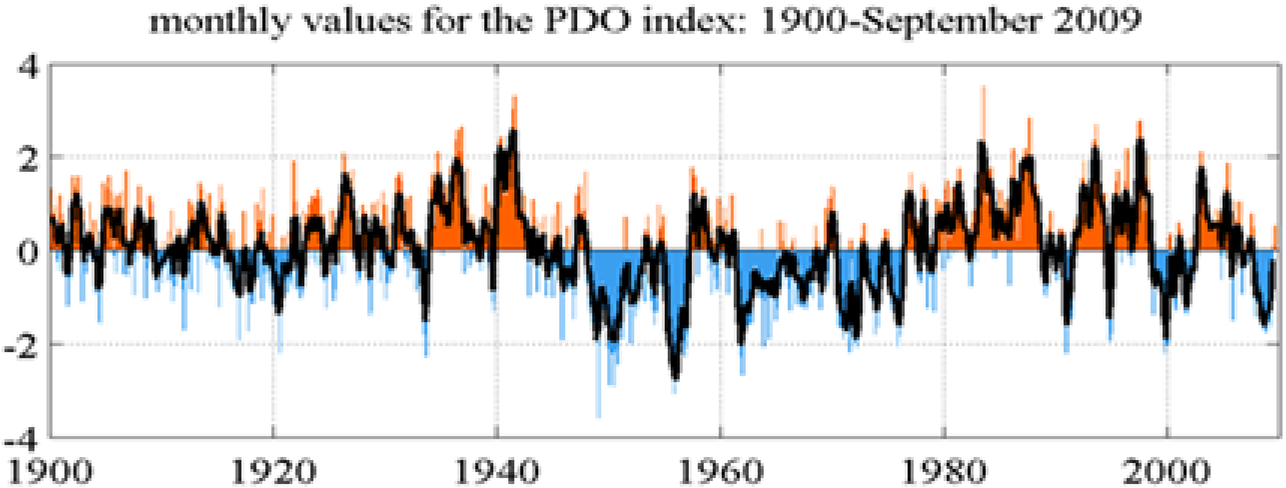


Figure 6. Behavior of the Pacific Decadal Oscillation (PDO) during the 20th and first part of the 21st century. Figure reproduced from http://jisao.washington.edu/pdo/

Another player that may have an impact on the winter and spring season storm track is the fact that the Pacific Decadal Oscillation (PDO) is in its negative phase. The PDO is an ENSO-like oscillation that occurs in the North Pacific (Northward of 20° latitude). However, unlike ENSO, the PDO tends to have a period of variability on interdecadal time scales (Figure 6). This means that one phase of the PDO will usually last a decade or two. The figure above displays the behavior of the PDO over the 20th and early 21st centuries. The red areas represent times in which the PDO was predominately in its positive phase. Conversely, the blue areas represent times that the negative phase dominated.

Figure 7 on the right displays the characteristics of the two phases of the PDO. The positive phase is characterized by warmer than average eastern Pacific water and cooler western and north central Pacific water. However, during the negative phase, the warmest SST anomalies are confined to the western and north central Pacific with relatively cool SSTs across the eastern Pacific.

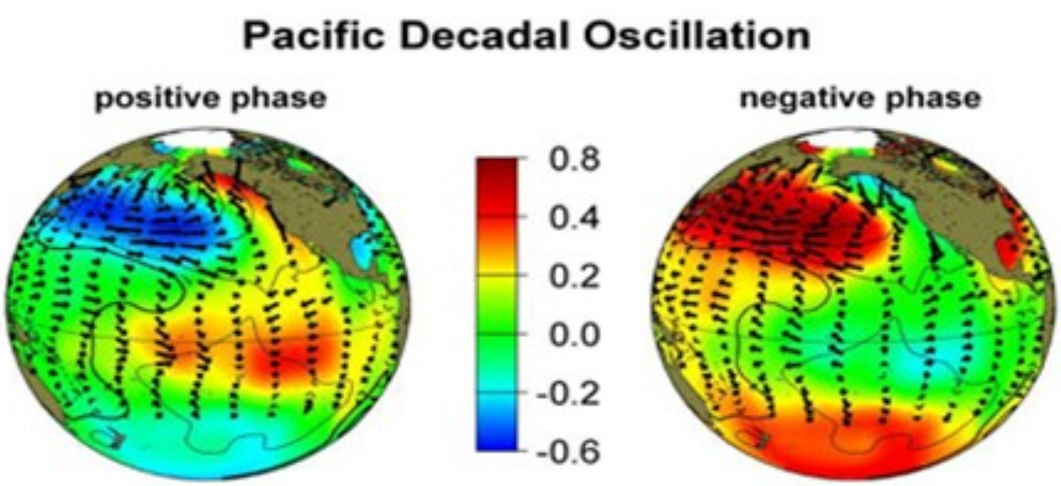


Figure 7. The typical sea surface temperature anomalies typically associated with the positive (left) and the negative (right) phases of the PDO. Figure reproduced from http://jisao.washington.edu/pdo/

La Niña: (cont)

Considering that the PDO and ENSO are in similar phases, (e.g., La Niña is the cool phase of ENSO and the negative PDO is the cool phase of the PDO) research suggests that this could enhance the typical La Niña winter and spring season impacts. This means that this La Niña event could have a stronger influence on the strength and location of the mean winter and spring season storm track.

The North Atlantic Oscillation

Yet another phenomenon that could have a large impact on this upcoming winter is the North Atlantic Oscillation (NAO). The NAO is a meridional dipole of atmospheric pressure anomalies across the North Atlantic. One center is located near Greenland while the other center of opposite sign is located across the central latitudes of the North Atlantic between 35°N and 40°N. The NAO, like the PDO, is characterized by a positive and a negative phase. The positive phase, shown in figure 8 below, is characterized by a stronger than normal Icelandic low. This is inferred from the negative pressure anomalies across the high latitudes of the Atlantic near Greenland (light blue shading). Conversely, farther south across the mid-latitudes of the Atlantic positive pressure anomalies occur. The negative phase (not shown) is characterized by the opposite conditions.

These pressure anomalies have a profound impact on the strength and geographical location of the storm track across eastern North America. The positive phase is known for producing a stronger upper level jet across the North Atlantic which makes it very difficult to get cold air to spill southward across the central and eastern United States. Therefore, warmer winter season conditions usually result across the central and eastern U.S. during this phase of the NAO. In contrast, the negative phase produces a weaker jet across the North Pacific which allows the storm track to drop southward across the central and eastern United States. This is known for producing cold and increased chances for snow across the eastern half of the states.

Given the impacts the NAO has on the winter season conditions; it is definitely another very important player for determining what this winter will bring. Unfortunately, the NAO is very difficult to predict more than a few weeks in advance. Research has shown the NAO to have variability on timescales ranging from a few weeks all the way up to several decades. The negative phase of the NAO has tended to dominate the winters over the past couple of years which has helped lead to some cold and snowy winter seasons. Given this tendency over the past few years, it is certainly possible that the NAO could be negative once again during a portion of this winter season.

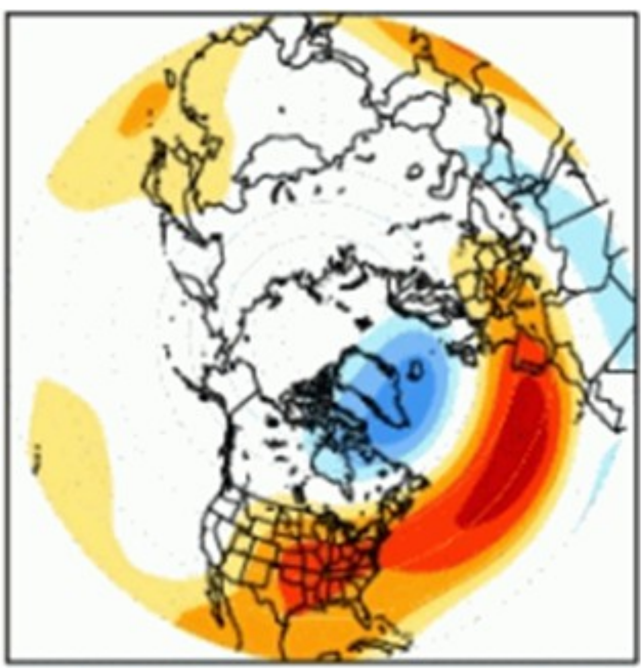


Figure 8. Atmospheric pressure anomalies typically associated with the positive phase of the North Atlantic Oscillation (NAO). The blue colors represent below average pressure, while the red colors are above average pressure. Courtesy of NOAA, Climate Prediction Center

La Niña: (cont)

Winter Outlook

Winter Season (December 2011 – February 2012):

Temperatures Precipitation

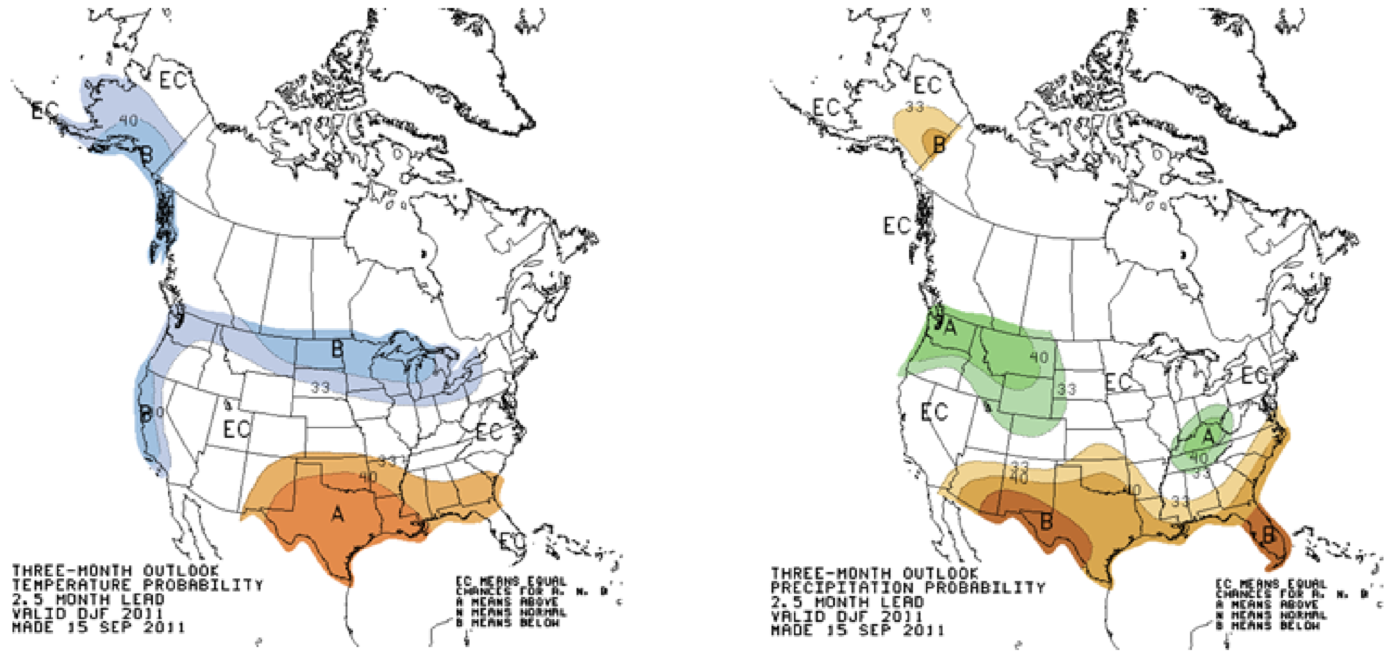


Figure 9. The Climate Prediction Center December 2011 through February 2012 temperature outlook (left) and precipitation outlook (right)

The national outlooks above are produced by the Climate Prediction Center (CPC). During the winter season (months of December through February) there is an enhanced chance for below average temperatures across the Northern Plains eastward across the Great Lakes (indicated by the blue shading on the left side of figure 9). Conversely, there are enhanced chances for warm conditions across the south central and the far southeastern United States. The white shading across the mid-Mississippi valley eastward towards the mid-Atlantic coast indicate equal chances of experiencing above average, near average and below average temperatures. The tools CPC uses do not show enough evidence for the forecaster to be confident enough to produce a more specific forecast in these areas. In contrast to temperatures, CPC is forecasting enhanced chances for experiencing above median precipitation during the winter season across southern Illinois and portions of the Ohio Valley (right side of figure 9). Next, we will examine results of local research to augment the CPC national outlooks.

Local Outlook

The following information is based on local research at the Chicago, IL office. This information is meant to supplement the official CPC outlook on the local scale. Results from Chicago are shown; however, the results are similar across north central Illinois and northwestern Indiana. Only the meteorological winter season (December through February) conditions are discussed in this section.

La Niña: (cont)

Temperatures:

Table 1 below displays the climatological average winter monthly and seasonal temperatures and snowfall along with the observed departures from average during the past 17 -PDO La Niña events (tan cells). Notice that monthly temperatures and snowfall during -PDO La Niña events (which is forecast this year) are slightly warmer and snowier than average. However, in spite of this, none of these anomalies are particularly impressive or statistically significant for that matter. This is what makes forecasting the conditions this winter very difficult for our area.

Table 1. Monthly and winter season: 1.) climatological average temperatures, 2.) Temperature anomalies during –PDO La Niña events, 3.) climatological average snowfall, 4.) Snowfall anomalies during –PDO La Niña events.

Chicago, IL		*-PDO La Niña*		*17 events*
	Average	*Anomaly*	*Average*	*Anomaly*
Month	*Temperature*	*Temperature*	*Snowfall*	*Snowfall*
December	28.7°F	+1.1°F	8.4”	-0.1”
January	24.3°F	+0.6°F	10.0”	+0.4”
February	27.2°F	+1.1°F	8.2”	+0.4”
Winter	26.7°F	+0.9°F	26.6”	+0.6”

Remember that the winter season storm track during these -PDO La Niña events supports the potential for stronger and more persistent arctic outbreaks across the north central U.S. and warm conditions across the south. This places northern Illinois and Northwestern Indiana in an interesting geographical position relative to the typical storm track during these events. Because of this, we saw that temperatures did not significantly deviate from average conditions. So, does this mean that La Niña events do not have a statistically significant impact on the area? In short, the answer is no. Let’s dig a bit deeper to demonstrate.

If we take a look at the winter season temperature distributions during these La Niña winters, along with those for the entire climatological time series, it is apparent from figure 10 that there are significant differences between the two. The graphs display the probability of exceedance for: the number of winter season days with high temperatures above 40°F (left-hand side), the number of winter season days with low temperatures below 10°F (right-hand side) and the average winter season temperature (bottom). The green lines represent the probabilities of exceedance for an average year (labeled Climo) while the blue lines represent those observed during the past 17 -PDO La Niña events. In order to interpret these graphs, consider for example the 50% and 30% percentiles on the x-axis (horizontal axis). For the number of winter season days with high temperatures above 40°F, an average winter would have a 50% chance of having 25 or more days above 40 degrees. Similarly, you can gather that there is a 30% chance of exceeding 30 days and a 10% chance of exceeding 39 days. However, during La Niña events, there are a corresponding higher number of days above 40 degrees for most of the higher (e.g., 90% through 40%) probabilities. For example, the 50th percentile increases from 25 days to around 27 days. In spite of this, notice that for the lower probabilities (e.g., 10% through 30%) of exceedance there are a lower number of days at or above 40 degrees. This same behavior is found for the number of cold low temperatures and the overall average winter season temperatures.

La Niña: (cont)

So what exactly does this mean? Well, overall these probabilities of exceedance graphics indicate that there is less variability in the number of days of warm and cold temperatures, and also less variability in the average winter season temperatures across northern Illinois during –PDO La Niña winters. For example, the bottom figure below shows that the entire climatological time series distribution has a range of winter season temperatures from 20.0° to 35.3°. In contrast, the range of winter season temperatures during –PDO La Niña winters is from 23.6° to 30.4°. The same can be said for the number of days with very warm and cold temperatures. Therefore, in spite of the fact average temperatures indicate an increased potential for warmer than average conditions this winter, the distribution of temperatures does not necessarily suggest this. Instead, this suggests that winter season temperatures could be close to average. This means that the winter as a whole will not necessarily be as warm as the anomalies shown above would suggest. It is noteworthy that this does not mean there will not be any warm days this winter.

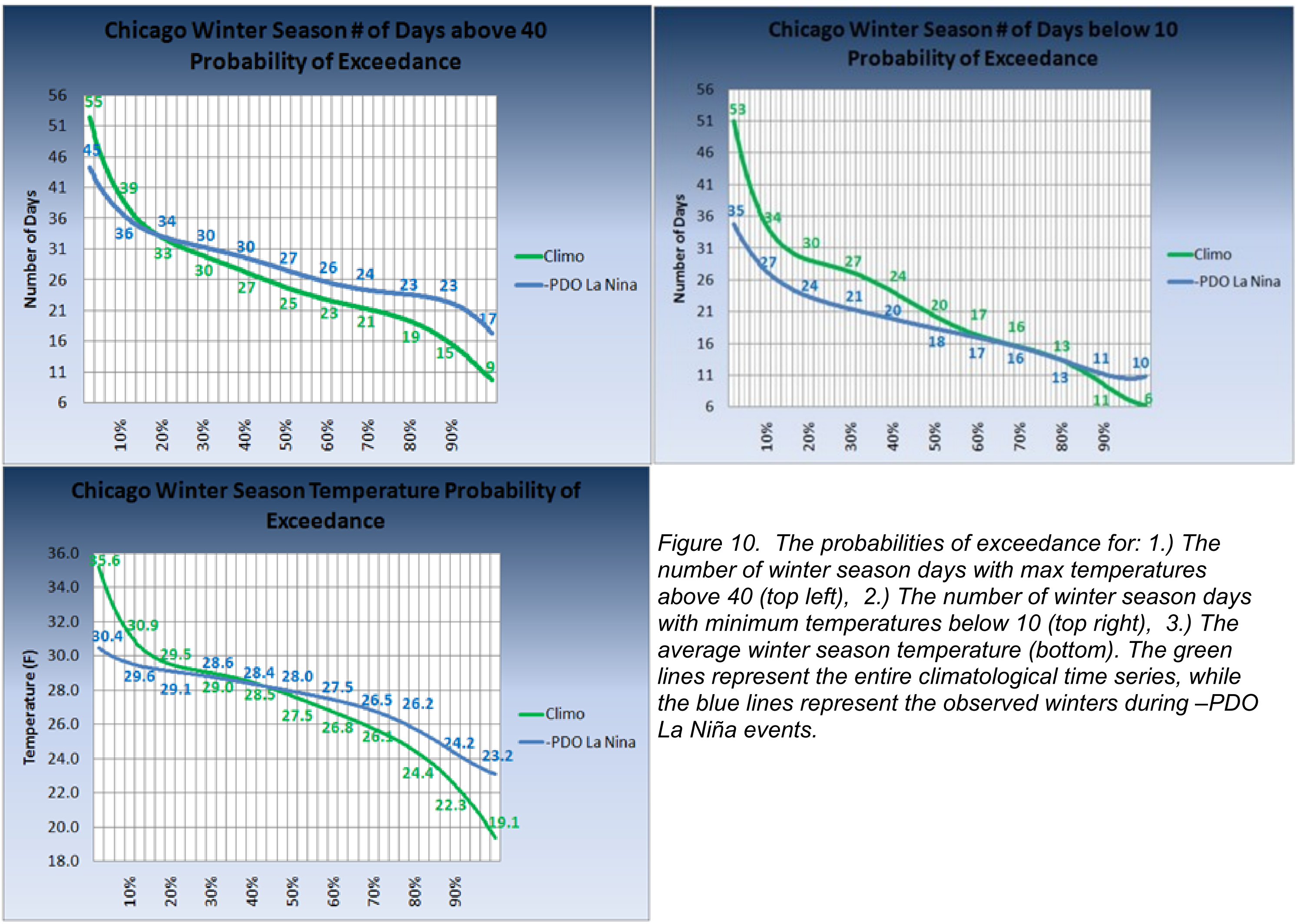


Figure 10. The probabilities of exceedance for: 1.) The number of winter season days with max temperatures above 40 (top left), 2.) The number of winter season days with minimum temperatures below 10 (top right), 3.) The average winter season temperature (bottom). The green lines represent the entire climatological time series, while the blue lines represent the observed winters during –PDO La Niña events.

La Niña: (cont)

As mentioned earlier, the NAO can also have big impacts on temperatures and snowfall during the winter season across the area. So what could this mean in addition to the possible effects from La Niña and the PDO? Well, consider figure 11 below. If the NAO goes into its negative phase again during portions of this upcoming winter, there is a decent possibility that this will lead to colder than average conditions across northern Illinois and northwestern Indiana. An analysis of winter season months in which La Niña conditions were present in the equatorial Pacific concurrently with the negative phase of the NAO suggests that there is a tendency for colder and snowy conditions, especially during the month of December (figure 11 below). The average monthly temperature for December was found to be in excess of 3 degrees Fahrenheit below average during these –NAO La Niña events.

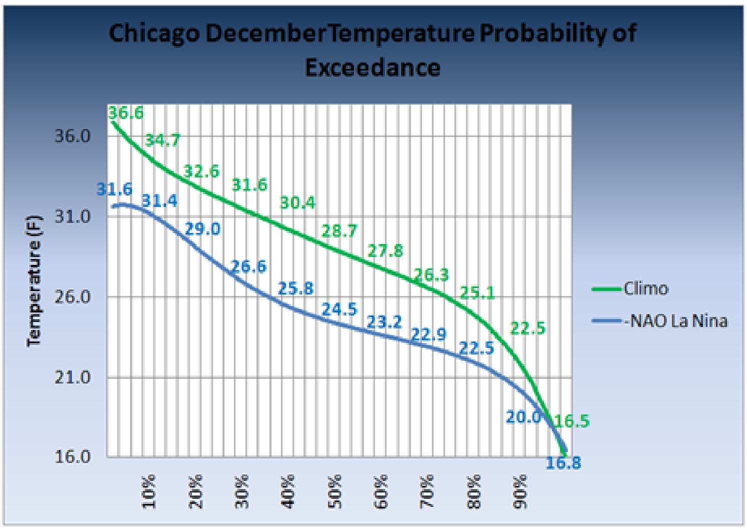


Figure 11. The probabilities of exceedance for the average December monthly temperature. The green lines represent the entire climatological time series, while the blue lines represent the observed winters during –NAO La Niña events.

Precipitation:

Winter season precipitation (rain and snow) tends to be above average during -PDO La Niña events. This is primarily due to the fact that an active storm track resides in the vicinity of the area. Figure 12 displays the probabilities of exceedance for liquid equivalent precipitation (left figure) and for snowfall amounts (right figure). The overall result is that there are higher probabilities for experiencing higher amounts of winter season precipitation/snowfall during these La Niña events. Also shown in figure 13 is the December monthly snowfall distribution during –NAO La Niña events. Average monthly snowfall was found to be nearly 4 inches above normal during December.

La Niña: (cont)

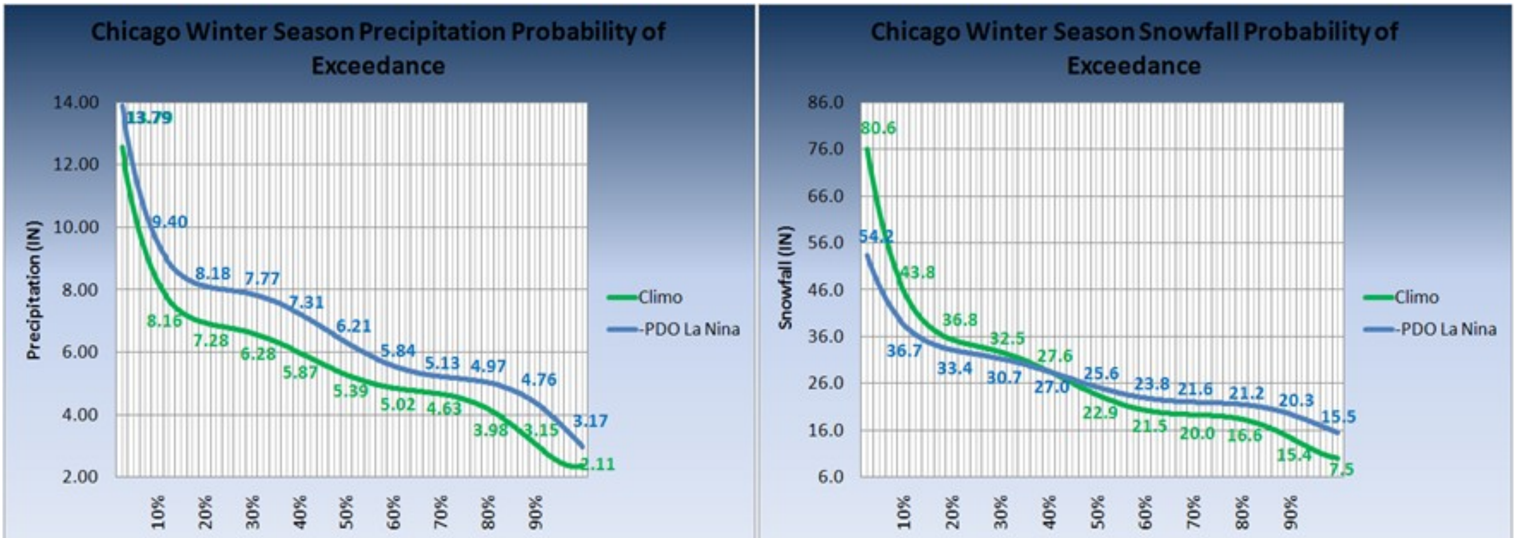


Figure 12. The probabilities of exceedance for the amount of winter season precipitation (left), and the amount of winter season snowfall (right). The green lines represent the entire climatological time series, while the blue lines represent the observed winters during –PDO La Niña events.

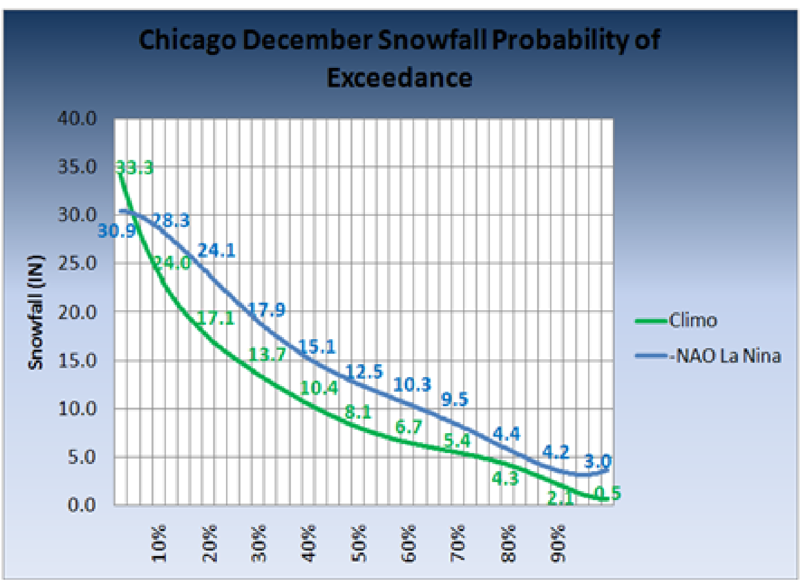


Figure 13. The probabilities of exceedance for the amount of snowfall during the month of December. The green lines represent the entire climatological time series, while the blue lines represent the observed winters during –NAO La Niña events.

La Niña: (cont)

In conclusion, La Niña, the PDO and the NAO could work constructively with each other to significantly I mpact the winter season conditions across North America. These naturally occurring climatic oscillations have been found to have significant impacts on the mean strength and location of the winter season storm track which directly impacts the amount of cold and snowfall an area will experience. Dynamic models indicate that La Niña and the negative phase of the NAO could help lead to colder and snowier than average conditions across the upper Mississippi valley and the western Great Lakes this winter. Therefore, it is quite possible that this winter will be similar to last winter. However, it is important to note that there are also other "less predictable" variables that can modulate the overall effects of La Niña across the area. This outlook is just meant to act as a guide showing an increased potential for more precipitation and near average to colder than average temperatures during the winter season of 2011-2012. Once again, this does not mean that there will not be any warm days or periods during the winter. It simply means that temperatures averaged over the entire winter and spring season could average near or below the climatological average. Expect to experience the typical day to day variability in temperatures commonly experienced during the winter.